Transition of MIL-HDBK-5 USAF → FAA

9 March 05

Defense Standardization Program Conference

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Battelle
The Business of Innovation

Introduction

Scope

MIL-HDBK-5 → Primary Source of Static Design Allowables for Metallic Materials and Structural Elements (Fasteners) that are Used in the Design of Aircraft and Aerospace Structures

Objective

Develop Design Properties from data generated and provided by industry and provide in a

Handbook Contents

MILITARY HANDBOOK

METALLIC MATERIALS AND ELEMENTS FOR AEROSPACE VEHICLE STRUCTURES

Table 3.2.3.0(b$_t$). Design Mechanical and Physical Properties of 2024 Aluminum Alloy Sheet and Plate—Continued

Specification	AMS-QQ-A-250/4								
Form	Sheet		Plate				Sheet		Plat
Temper	T81		T851				T861		
Thickness							0.063-0.249		0.25-0.50
Basis	S	B	S	B	S	B	S	S	S
Mechanical Properties:									
F_{tu}, ksi:									
L	67	68	67	68	66	66	71	72	70
LT	67	68	67	68	66	66	70	71	70
F_{ty}, ksi:									
L	59	61	58	60	58	57	63	67	64
LT	58	60	58	60	58	57	62	66	64
F_{cy}, ksi:									
L	59	61	58						
LT	58	60	59						
F_{su}, ksi	40	41	38						
F_{bru},[a] ksi:									
(e/D = 1.5)	100	102	102						
(e/D = 2.0)	127	129	131						
F_{bry},[a] ksi:									
(e/D = 1.5)	83	86	86						
(e/D = 2.0)	94	97	101						
e, percent (S-basis):									
LT	5	...	5						
E, 10^3 ksi									
E_c, 10^3 ksi									
G, 10^3 ksi									
μ									
Physical Properties:									
$\dot{u}$, lb/in.^{3}									
C, Btu/(lb)(° F)									
K, Btu/[(hr)(ft^2)(° F)/ft]									
$\hat{a}$, 10^{-6} in./in./° F									

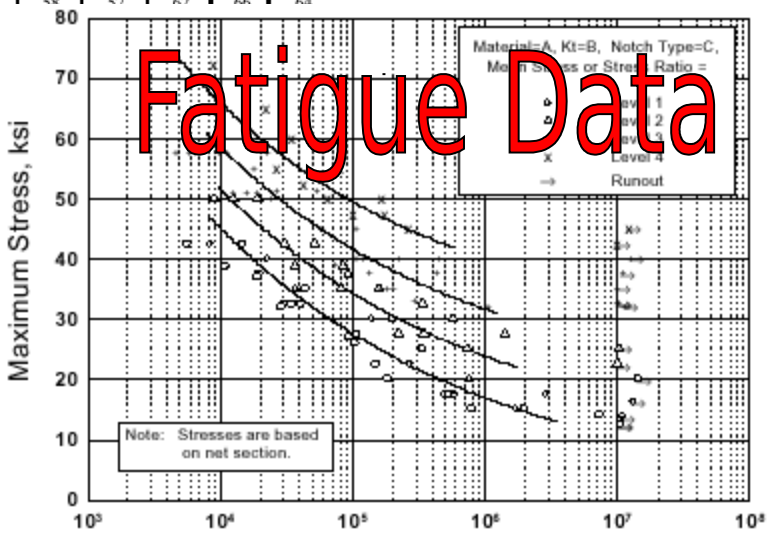
a Bearing values are "dry pin" values per Section 1.4.7.1
b See Table 3.1.2.1.1.

Material Allowables

Table 8.1.2.2(g). Static Joint Strength of 100- Flush Head Aluminum Alloy (5056-H321) Solid Rivets in Machine-Countersunk Magnesium Alloy Sheet

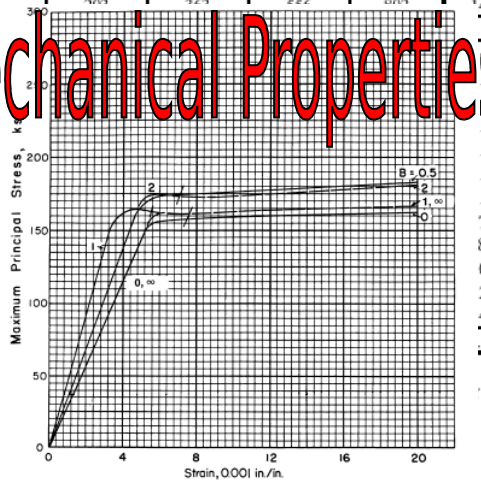
Rivet Type	MS20426B (F_{su} = 28 ksi)				
Sheet Material	AZ31B-H24				
Rivet Diameter, in. (Nominal Hole Diameter, in.)	3/32 (0.096)	1/8 (0.1285)	5/32 (0.159)	3/16 (0.191)	1/4 (0.257)
Sheet thickness	Ultimate Strength, lb				
0.032	72[a,b]	...	...	...	...
0.040	180	304	...	...	...
0.050	190	318	467[a,b]	...	...
0.063	203	337	490	679[a,b]	...
0.071	...	348	503	697[a]	...
0.080	...	360	519	715	...
0.090	...	363	536	737	1244[b]
0.100	...	...	554	757	1271
0.125	...	...	556	802	1343
...	...	...	...	...	1440
...	...	...	...	...	1450
ngth[c] ...	...	...	...	...	1450

Fastener Joint Allowables



Fatigue Data

Figure 1.4.9.2(a). Best fit S/N curve diagram for a material at various stress ratios.



Mechanical Properties

Figure 2.3.1.3.6(d). Typical biaxial stress-strain curves at room temperature for AISI 4340 alloy steel (machined thin-wall cylinders, axial direction = longitudinal direction of bar stock), F_{tu} = 180 ksi. A biaxial ratio, B, denotes the ratio of hoop stresses to axial stresses.

Handbook Evolution

- **1937 - Predecessor Document to MIL-HDBK-5 (ANC-5) First Issued (ANC -- Army, Navy, Commerce)**
- **1956 - Air Force Assumed Responsibility for Maintaining ANC-5**
- **1959 - First Issue of MIL-HDBK-5 Published**
- **1971 - Incorporated detailed guidelines for statistical analysis of data**
- **1997 – Formalized Industry Steering Group (ISG) to complement government-supported coordination activities**
- **2001 – Began transition of government leadership of MIL-HDBK-5 coordination from Air Force to Federal Aviation Administration**

Handbook Process

- **Government/industry collaborative effort**
- **Network of steering, working and task groups responsible for setting goals, planning, tasking, etc.**
- **All proposed handbook revisions subject to formal review process on Bi-Annual Basis (Spring and Fall) at General Coordination Committee (GCC) meeting**
- **Implementation of revisions requires approval of GCC composed of Industry, Government and unbiased third party secretariat**

Industry Participation

- **Aerospace industry (suppliers and manufacturers) has been a key player in handbook activities.**
- **Source for information entered in handbook and responsible party for:**
  - **Registering new materials developed**
  - **Developing material specifications**
  - **Testing materials to generate design allowables**
- **Active in handbook process:**
  - **Participate in GCC meeting where decisions are made to the entry, deletion, or modification of handbook contents**
  - **Provide review, feedback, and input to agenda items and meeting minutes from GCC meetings**

What Happened?!?

Need to Transition

- ***Charter: Establish New Direction/transition Strategy for MIL-HDBK-5 Process***
- ***S&T Budget Reduction.***
- ***No Contribution From Army, Navy, NASA.***
- ***Bridge Funding Exhausted.***

Recommended Approach

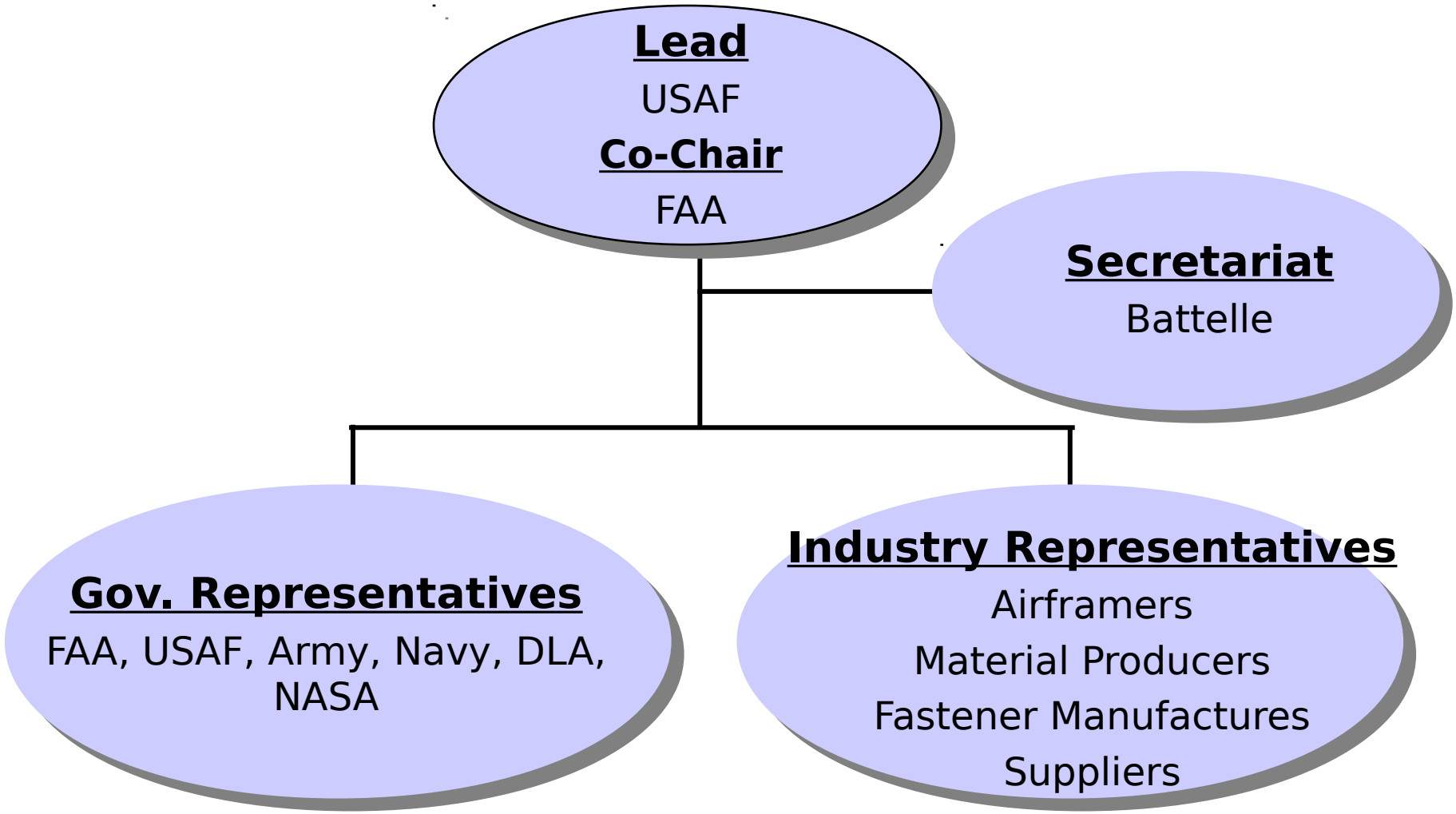
- **FAA contracts with Battelle using current MIL-HDBK-5 “process”.**
- **Coordination meetings similar to AF contract.**
- **Document created entitled Metallic Materials Properties Development and Standardization (MMPDS) Handbook.**
  - **Format identical to MIL-HDBK-5 document.**

Pros	Cons
•Restored level of effort.	•Loss of DoD custodianship.
•Governmental control of data rights.	•No longer a “military handbook”.
•Document virtually identical to military handbook.	•Questions about use of data for design of military aircraft.
	•Requires transfer of historical documents and archival raw data.

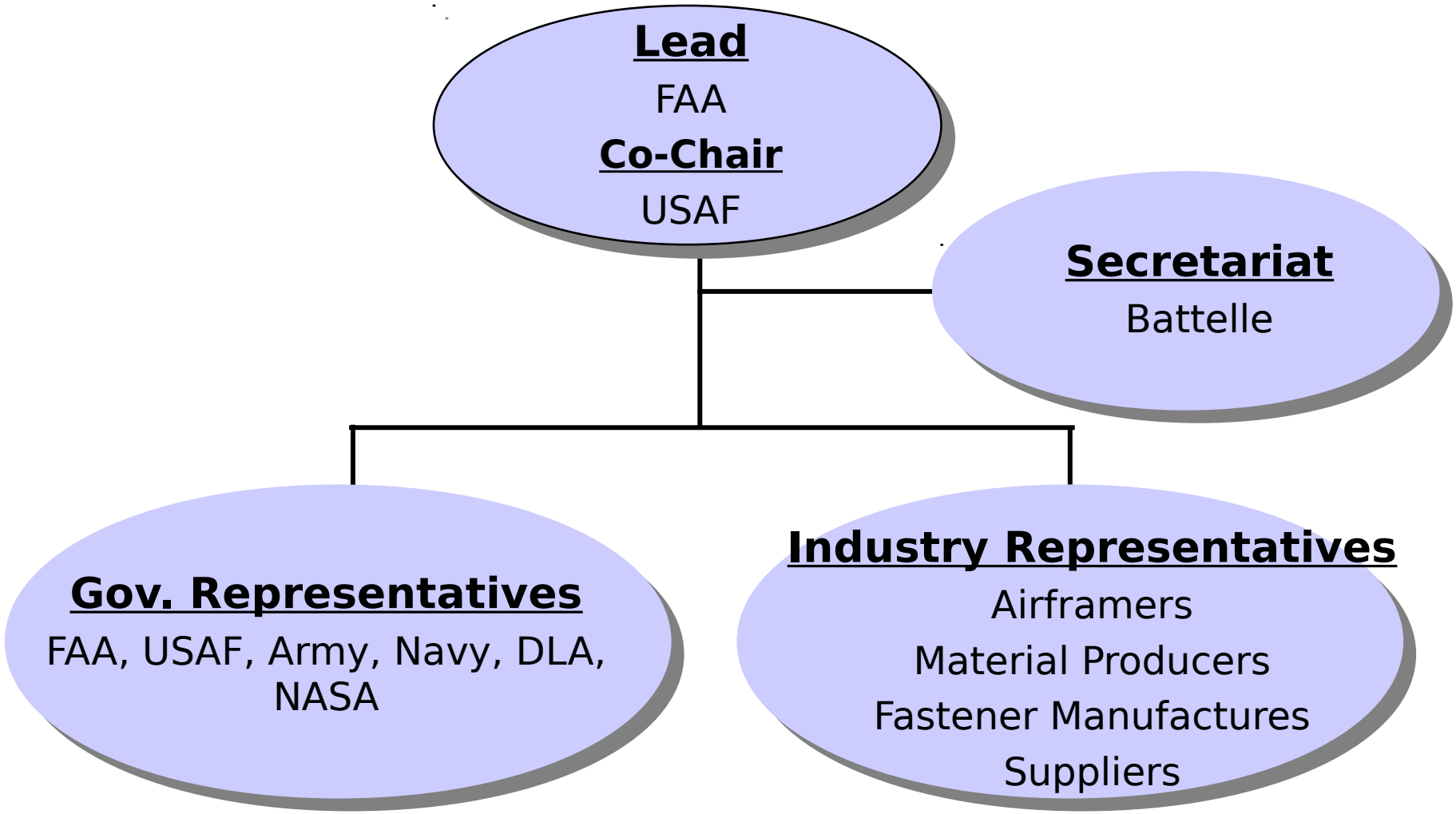
Implementation

- **Establish AFRL/FAA MOA (May 02)**
  - **4 year agreement with optional 2 year extension.**
  - **Continued AFRL access to all medias and publications.**
  - **Continued Co-Chairmanship of activity.**
  - **Corporate Board Membership with provision for document at no cost.**
- **Ensure FAA access to archival/historical records (15 filing cabinets).**
- **Continued technical engineering support from AFRL.**

Organization (Pre-Transition)



Organization (Post-Transition)



Transition Status

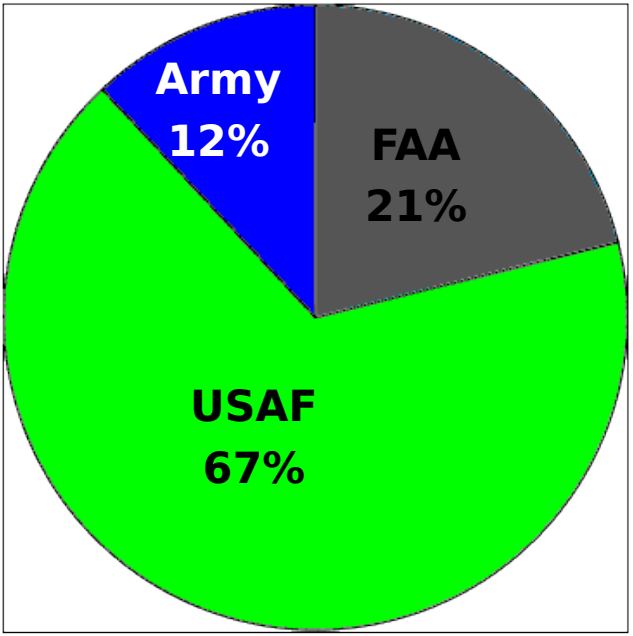
- April 2002 – 1st MMPDS, 101st MIL-HDBK-5 Coordination Meeting, Atlantic City, NJ.
- September 2002 – FAA Contract with Battelle to continue support of MIL-HDBK-5 process and development of MMPDS.
- October 2002 – 2nd MMPDS, 102nd MIL-HDBK-5 Coordination Meeting, Cocoa Beach, FL.
- February 2003 – First version of MMPDS/final version of MIL-HDBK-5.
- April 2003:
  - 3rd MMPDS Coordination Meeting, Las Vegas, NV.
  - Drafts of MMPDS Management/Commercialization Plans.
- May 2004 – MIL-HDBK-5 Cancellation Notice released.
- June 2004 – MMPDS Survey on Commercialization sent to users.
- October 2004 – Survey results discussed.

Management Plan

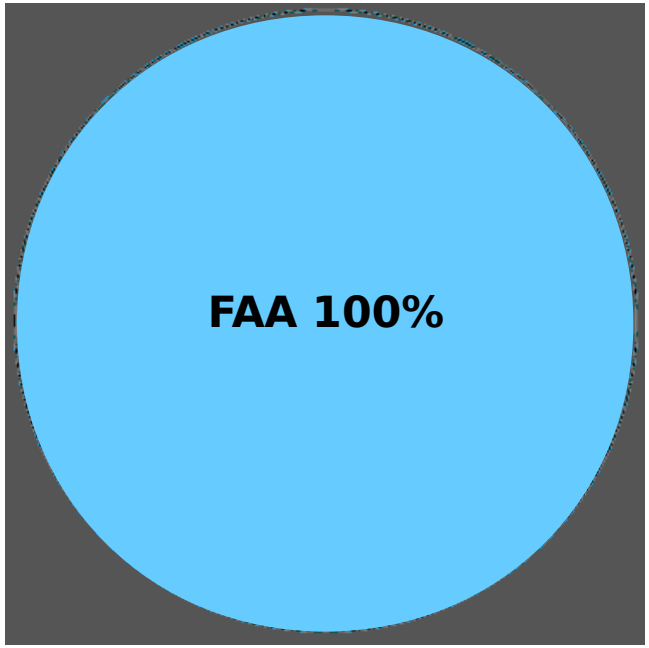
- **Goal: Establish more equitable and sustainable sponsorship for the MMPDS**
  - **Target FAA Share: 33%**
- **Potential Avenues:**
  - **Expand and Strengthen Membership of Governmental Partners**
  - **Draw Increased Support from Industry**
  - **Sell handbook to Non GSG and ISG members**

Targeted Funding Profile

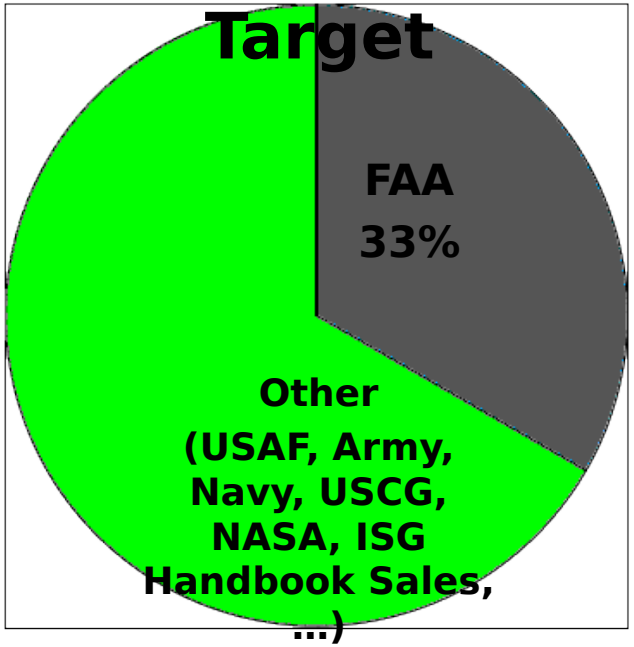
MIL-HDBK-5



Transition

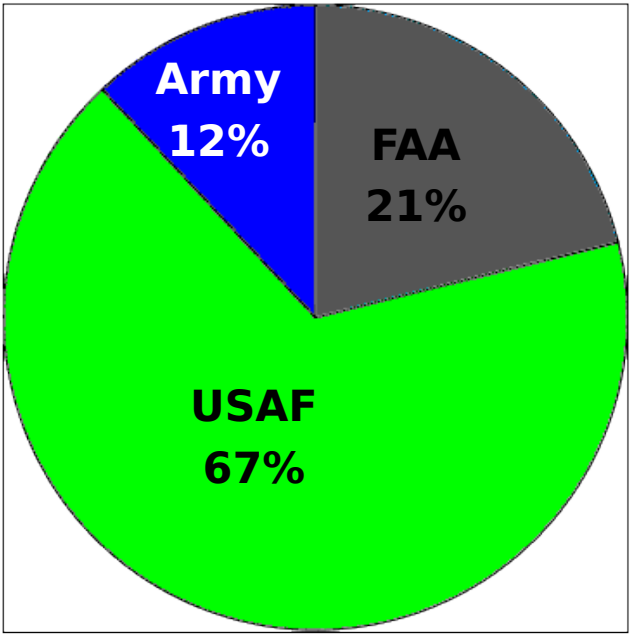


Original MMPDS Target



Targeted Funding Profile

MIL-HDBK-5



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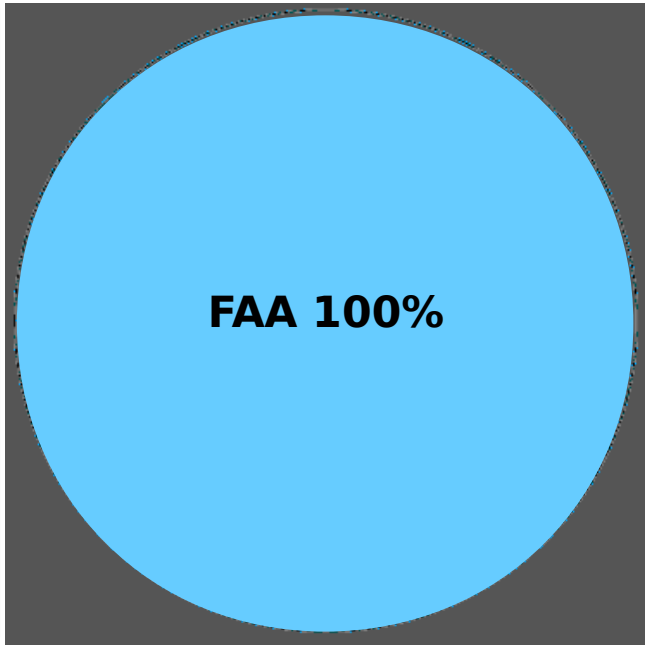
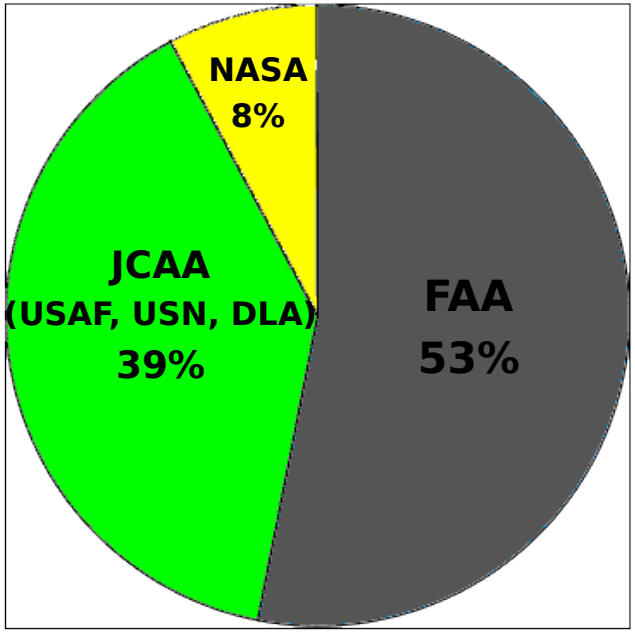
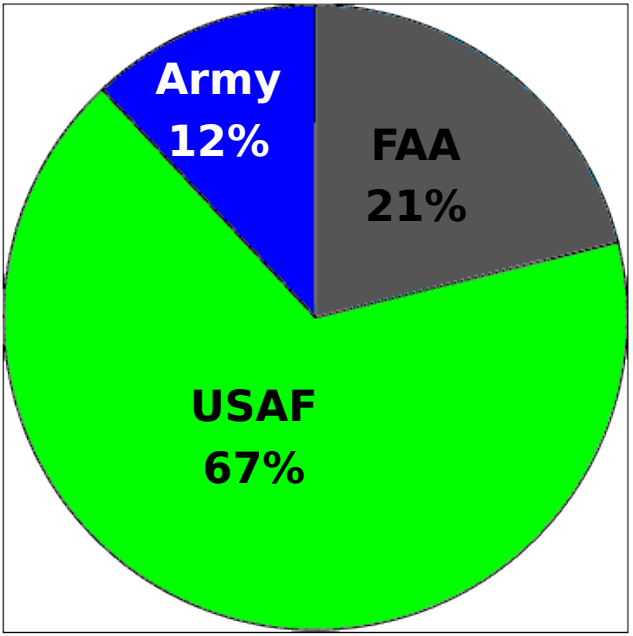


MMPDS Today



Targeted Funding Profile

MIL-HDBK-5



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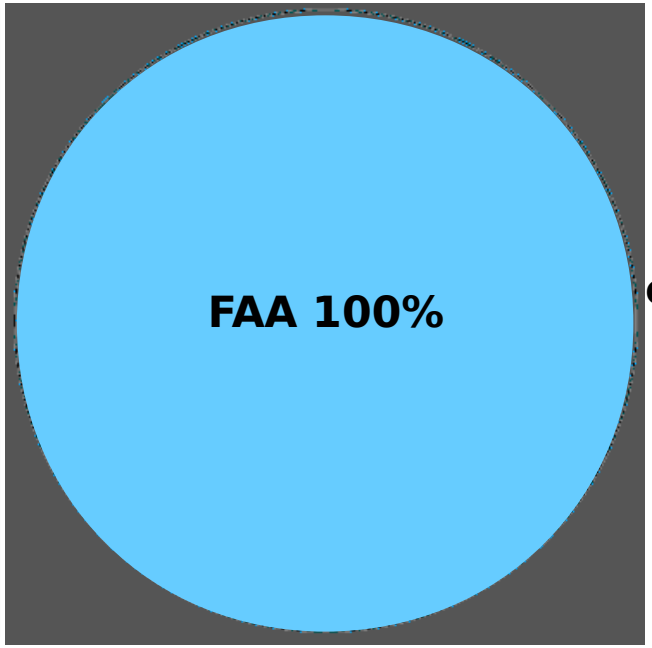
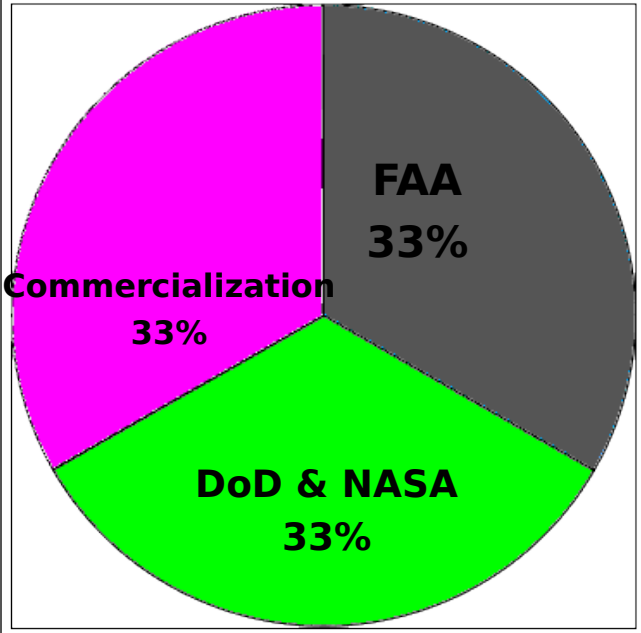


MMPDS Target



Commercialization Plan

- **Broaden Government/Industry cooperative efforts, thereby pooling resources and sharing benefits and results.**
  - **Government regulatory role shall be maintained.**
- **Develop more positive incentives to broaden active government and industry participation and sustain required funding base.**
  - **Copyright control**
- **Provide supplemental revenue for Handbook coordination efforts.**
  - **Licensing agreements for reproduction and distribution of MMPDS products**
  - **Users must pay for access to currently approved design data**
  - **Net income from sales to be re-invested into coordination activities**

Summary

- **Handbook is still the premier source for static design allowables for metallic materials and structural elements used in the design of aircraft and aerospace structures.**
- **Maintain a standardized process for establishing statistically based allowables required for aircraft certification and continued airworthiness.**
- **Active government/industry coordination is essential to maintain the integrity of the design allowable and guideline development process.**
- **Encouraging and obtaining broader government and industry support for the long term health of the handbook.**